CLAIMS

1. A frequency division duplexing (FDD) wireless communication method for use by a base station, a first terminal, and a second terminal, wherein the base station transmits using a downlink subframe on a first channel and the first and second terminals transmit using an uplink subframe on a second channel, wherein the downlink subframe includes a broadcast preamble, a time division multiplex (TDM) portion, and a Time Division Multiple Access (TDMA) portion, and wherein the TDMA portion includes at least one modulation/forward error correction (PHY) mode with an associated preamble, both of which are intended for the second terminal, the method comprising:

transmitting a broadcast preamble from a base station to a first terminal and a second terminal during a downlink subframe on a first channel;

synchronizing the first terminal and the second terminal to the base station based on the broadcast preamble;

transmitting modulated data from the second terminal to the base station during an uplink subframe on a second channel;

transmitting modulated data from the base station to the first terminal during a TDM portion of the downlink subframe on the first channel after the first terminal is synchronized with the base station;

transmitting a preamble from the base station during a TDMA portion of the downlink subframe on the first channel, wherein the preamble is transmitted after the second terminal has transmitted its modulated data to the base station; and

re-synchronizing the second terminal with the base station based on the preamble transmitted by the base station on the first channel.

2. The method of Claim 1, further comprising transmitting modulated data from the base station to the second terminal during the TDMA portion of the downlink subframe on the first channel after the second terminal is re-synchronized with the base station.

3. The method of Claim 2, further comprising transmitting a broadcast downlink map during the downlink subframe from the base station which indicates when the TDM portion of the downlink subframe transitions to the TDMA portion of the downlink subframe.

4. The method of Claim 3, wherein the broadcast downlink map includes at least one time indicator and an associated downlink interval usage code (DIUC), wherein the DIUC indicates the TDMA portion.

5. The method of Claim 4, further comprising transmitting a broadcast uplink map during the downlink subframe by the base station which indicates when the second terminal is scheduled to transmit to the base station during the uplink subframe on a second channel.

6. The method of Claim 5, wherein the broadcast downlink map identifies a beginning of the TDMA portion within the downlink subframe and the broadcast uplink map identifies when the second terminal is scheduled to transmit during a next uplink subframe.

7. The method of Claim 5, wherein the downlink subframe and the uplink subframe have a combined duration of 0.5 milliseconds.

8. The method of Claim 5, wherein the downlink subframe and the uplink subframe have a combined duration of 1 milliseconds.

9. The method of Claim 5, wherein the downlink subframe and the uplink subframe have a combined duration of 2 milliseconds.

10. The method of Claim 5, wherein the duration of the downlink subframe on the first channel and the duration of the uplink subframe on the second channel vary over time.

11. The method of Claim 5, further comprising transmitting modulated data from the first terminal to the base station during the uplink subframe on the second channel.

12. The method of Claim 11, wherein transmitting by the second terminal and transmitting by the first terminal are performed using different PHY modes.

13. The method of Claim 11, wherein transmitting to the first terminal and transmitting to the second terminal, both by the base station, is performed using different PHY modes.

14. The method of Claim 11, wherein transmissions during the uplink subframe and the downlink subframe are modulated using Quadrature Amplitude Modulation (QAM) symbols of adaptable modulation density.

15. The method of Claim 11, wherein transmissions during the uplink subframe and the downlink subframe comprise Orthogonal Frequency Division Multiplexing (OFDM) symbols of adaptable modulation density.

16. The method of Claim 12, wherein the first terminal and the second terminal use the same modulation type with different forward error correction types.

17. The method of Claim 2, wherein the first terminal operates in a full-duplex fashion and the second terminal operates in a half-duplex fashion.

18. The method of Claim 2, wherein the first and second terminals operates in a half-duplex fashion.

19. The method of Claim 18, further comprising transmitting modulated data by the first terminal on a second channel during an uplink subframe after the first terminal receives modulated data during the downlink subframe.

20. The method of Claim 18, further comprising transmitting modulated data by the second terminal on a second channel during an uplink subframe before the second terminal receives modulated data during the downlink subframe.

21. The method of Claim 2, wherein the first and second terminals operate in a full-duplex fashion.

22. The method of Claim 21, further comprising transmitting the TDMA portion during the downlink subframe from the base station using a smart antenna.

23. A method for conveying data in a downlink over a communication link, the method comprising:

providing a downlink subframe with a time division multiplex (TDM) portion, including at least one TDM section, and a Time Division Multiple Access (TDMA) portion, including at least one TDMA section with an associated preamble;

beginning the downlink subframe with a broadcast preamble;

establishing a downlink map for the downlink subframe, the downlink map indicating one or more time positions within the downlink subframe where the at least one TDM section begins, and indicating one or more time positions within the downlink subframe where the at least one TDMA section begins;

transmitting the downlink map in the downlink subframe after the broadcast preamble; and

transmitting all TDM sections and all TDMA sections, along with each associated preamble, within the downlink subframe after transmitting the downlink map.

24. The method of Claim 23, further comprising:

transmitting the TDMA portion after at least one TDM section.

25. The method of Claim 24, further comprising:

dividing the TDM portion according to physical parameters of data recipients, including differences in the combination of modulation type and forward error correction (FEC) types used by the data recipients.

26. A time division duplexing (TDD) wireless communication method for use by a base station and a first terminal and a second terminal, wherein the base station transmits using a downlink subframe and the terminals transmit using an uplink subframe, both on the same channel, wherein the downlink subframe includes a broadcast preamble and a Time Division Multiple Access (TDMA) portion, and wherein the TDMA portion includes a first modulation/forward error correction (PHY) mode with an associated preamble which is only intended for the first terminal, and a second PHY mode with an associated preamble which is only intended for the second terminal, the method comprising:

transmitting a broadcast preamble from a base station to a first terminal and a second terminal during a downlink subframe;

synchronizing the first and the second terminals to the base station based on the broadcast preamble;

transmitting a first preamble by the base station using a smart antenna to only the first terminal after transmitting the broadcast preamble, wherein the first preamble is associated with a first PHY mode;

re-synchronizing the first terminal with the base station based on the first preamble transmitted by the base station;

transmitting modulated data from the base station using the smart antenna to only the first terminal during the downlink subframe using the first PHY mode after the first terminal is synchronized with the base station;

transmitting a second preamble from the base station using the smart antenna to only the second terminal after transmitting the modulated data to the first terminal, wherein the second preamble is associated with a second PHY mode; and

re-synchronizing the second terminal with the base station based on the second preamble transmitted by the base station.

27. The method of Claim 26, further comprising transmitting modulated data from the base station to only the second terminal during the downlink subframe using the second PHY mode after the second terminal is synchronized with the base station.

28. The method of Claim 27, further comprising transmitting a broadcast downlink map by the base station and during the downlink subframe which indicates when the first preamble is to be transmitted by the base station.

29. The method of Claim 28, wherein the broadcast downlink map includes at least one time indicator and a downlink interval usage code (DIUC), wherein the DIUC is indicative of the first PHY mode.

30. The method of Claim 29, further comprising transmitting a broadcast uplink map by the base station and during the downlink subframe which indicates when the first terminal is to transmit modulated data to the base station during an uplink subframe.

31. The method of Claim 30, wherein the downlink subframe and the uplink subframe have a combined duration of 0.5 milliseconds.

32. The method of Claim 30, wherein the downlink subframe and the uplink subframe have a combined duration of 1 milliseconds.

33. The method of Claim 30, wherein the downlink subframe and the uplink subframe have a combined duration of 2 milliseconds.

34. The method of Claim 30, wherein the duration of the downlink subframe and the duration of the uplink subframe vary over time.

35. The method of Claim 30, wherein transmitting to the first terminal and transmitting to the second terminal, both by the base station, is performed using different PHY modes.

36. The method of Claim of 35, wherein transmissions during the uplink subframe and the downlink subframe are modulated using Quadrature Amplitude Modulation (QAM) symbols of adaptable modulation density.

37. The method of Claim 35, wherein transmissions during the uplink subframe and the downlink subframe comprise Orthogonal Frequency Division Multiplexing (OFDM) symbols of adaptable modulation density.

38. The method of Claim 35, wherein the first terminal and the second terminal use the same modulation type with different forward error correction types.

39. A frequency division duplexing (FDD) wireless communication system including a base station, at least one full-duplex terminal, and at least one half-duplex terminal, wherein the base station transmits using a downlink subframe on a first channel and the full-duplex and half-duplex terminals transmit using an uplink subframe on a second channel, wherein the downlink subframe includes a broadcast preamble, a time division multiplex (TDM) portion, and a Time Division Multiple Access (TDMA) portion, and wherein the TDMA portion includes at least one modulation/forward error correction (PHY) mode with an associated preamble, both of which are intended for the at least one half-duplex terminal, the system comprising:

at least one half-duplex terminal configured to alternate between transmitting on a first channel and receiving on a second channel;

at least one full-duplex terminal configured to transmit on the first channel while receiving on the second channel; and

a base station configured to transmit a broadcast preamble to the half-duplex terminal and the full-duplex terminal during a TDM portion of a downlink subframe and to transmit a preamble during a TDMA portion of the downlink subframe, wherein the half-duplex terminal synchronizes with the base station based on the broadcast preamble and re-synchronizes with the base station based on the preamble.

40. The system of Claim 39, further comprising a smart antenna coupled to the base station and configured to transmit the preamble to only the at least one half-duplex terminal during the TDMA portion of the downlink subframe.

41. A time division duplexing (TDD) wireless communication system including a base station, a first terminal, and a second terminal, wherein the base station transmits during a downlink subframe and the first and second terminals transmit during an uplink subframe, both on a same channel, wherein the downlink subframe includes a broadcast preamble and a Time Division Multiple Access (TDMA) portion, and wherein the TDMA portion includes a first modulation/forward error correction (PHY) mode with an associated preamble which is only intended for the first terminal, and a second PHY mode with an associated preamble which is only intended for the second terminal, the system comprising:

a first terminal configured to alternate between transmitting and receiving on a first channel;

a second terminal configured to alternate between transmitting and receiving on the first channel;

a base station configured to transmit a broadcast preamble to the first and second terminals during a TDM portion of a downlink subframe and to transmit a preamble during a TDMA portion of the downlink subframe, wherein the first terminal synchronizes with the base station based on the broadcast preamble and re-synchronizes with the base station based on the preamble; and

a smart antenna coupled to the base station and configured to transmit the preamble to only the first terminal during the TDMA portion of the downlink subframe.

42. A method for scheduling modulation/forward error correction (PHY) modes for a frequency division duplex (FDD) communication system which includes a plurality of terminals and a base station, both configured to communicate using adaptive modulations in a downlink subframe and an uplink subframe, with each of the plurality of terminals having an associated preferred downlink PHY mode, D_1, D_2, ... D_N, wherein D_1 is a most robust modulation and D_N is a least robust modulation, and wherein each of the plurality of terminals and their associated preferred downlink PHY mode have an associated uplink PHY mode, U_1, U_2, U_N, and wherein U_1 is associated with the plurality of terminals that have the preferred downlink PHY mode D_1, and wherein U_N is associated with the plurality of terminals that have the preferred downlink PHY mode D_N, such that a number of downlink map entries does not exceed $2N + 1$, the method comprising:

grouping the plurality of terminals based on preferred downlink PHY modes;

allocating uplink bandwidth in an uplink subframe such that the plurality of terminals are put in order of their preferred downlink PHY modes, from a second most robust preferred downlink PHY mode and continuing in order of decreasing robustness with a most robust preferred downlink PHY mode last;

allocating the plurality of terminals that use a D_1 PHY mode to begin at a start of a downlink subframe;

if a time duration of the D_1 PHY mode is less than a time duration of a U_2 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use a D_2 PHY mode, beginning at a time that the U_2 PHY mode ends;

if the time duration of the D_1 PHY mode is greater than or equal to the time duration of the U_2 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_2 PHY mode, beginning at an end of the D_1 PHY mode;

if a time duration of the D_2 PHY mode is less than a time duration of a U_3 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use a D_3 PHY mode, beginning at a time that the U_3 PHY mode ends;

if the time duration of the D_2 PHY mode is greater than or equal to the time duration of the U_3 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_3 PHY mode, beginning at an end of the D_2 PHY mode;

if the time duration of the D_3 PHY mode is greater than the sum of a time duration of a U_4 PHY mode, a U_5 PHY mode, and a U_1 PHY mode, segmenting the plurality of terminals that use the D_3 PHY mode and inserting the segments into any gaps in the downlink subframe;

if a time duration of the D_3 PHY mode is less than a time duration of the U_4 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use a D_4 PHY mode, beginning at a time that the U_4 PHY mode ends;

if the time duration of the D_3 PHY mode is greater than or equal to the time duration of the U_4 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_4 PHY mode, beginning at an end of the D_3 PHY mode;

if a time duration of the D_4 PHY mode is less than a time duration of the U_5 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use a D_5 PHY mode, beginning at a time that the U_5 PHY mode ends;

if the time duration of the D_4 PHY mode is greater than or equal to the time duration of the U_5 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_5 PHY mode, beginning at an end of the D_4 PHY mode;

if the time duration of the plurality of terminals that use the D_5 PHY mode is longer in duration than a combined time duration of the U_1 PHY mode and gaps that

are not aligned with the U_5 PHY mode, rearranging allocated downlink bandwidth of the downlink subframe to accommodate a remainder of the D_5 PHY mode such that the remainder is not aligned with the U_5 PHY mode; and

if the time duration of the plurality of terminals that use the D_5 PHY mode is shorter in duration than the combined time duration of the U_1 PHY mode and the gaps that are not aligned with the U_5 PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_5 PHY mode beginning at the end of the D_4 PHY mode and also interleaved in the gaps in the downlink subframe.

43. A method for scheduling modulation/forward error correction (PHY) modes for a frequency division duplex (FDD) communication system which includes a plurality of terminals and a base station, both configured to communicate using adaptive modulations in a downlink subframe and an uplink subframe, with each of the plurality of terminals having an associated preferred downlink PHY mode, D_1, D_2, ... D_N, wherein D_1 is a most robust modulation and D_N is a least robust modulation, and wherein each of the plurality of terminals and their associated preferred downlink PHY mode have an associated uplink PHY mode, U_1, U_2, U_N, and wherein U_1 is associated with the plurality of terminals that have the preferred downlink PHY mode D_1, and wherein U_N is associated with the plurality of terminals that have the preferred downlink PHY mode D_N, such that a number of downlink map entries does not exceed $2N + 1$, the method comprising:

grouping the plurality of terminals based on preferred downlink PHY modes;

allocating uplink bandwidth in an uplink subframe such that the plurality of terminals are put in order of their preferred downlink PHY modes, from a second most robust preferred downlink PHY mode and continuing in order of decreasing robustness with a most robust preferred downlink PHY mode last;

allocating the plurality of terminals that use a D_1 PHY mode to begin at a start of a downlink subframe;

if a time duration for the plurality of terminals that have a D_N PHY mode is less than a time duration for the plurality of terminals that are assigned to a U_{N+1} PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_N PHY mode, beginning at a time that a U_N PHY mode ends;

if the time duration for the plurality of terminals that have the D_N PHY mode is greater than or equal to the time duration for the plurality of terminals that are assigned to the U_{N+1} PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_N PHY mode, beginning at an end of a D_{N-1} PHY mode;

if the time duration of the plurality of terminals that have the D_N PHY mode is longer in duration than a combined time duration of a U_1 PHY mode and gaps that are not aligned with the U_N PHY mode, rearranging downlink bandwidth of the downlink subframe to accommodate a remainder of the D_N PHY mode such that the remainder is not aligned with the U_N PHY mode; and

if the time duration of the plurality of terminals that have the D_N PHY mode is shorter in duration than the combined time duration of the U_1 PHY mode and the gaps that are not aligned with the U_N PHY mode, allocating bandwidth of the downlink subframe to the plurality of terminals that use the D_N PHY mode, beginning at the end of the D_{N-1} PHY mode and also interleaved in the gaps in the downlink subframe.

44. A frequency division duplexing (FDD) wireless communication method for use by a base station and a first terminal and a second terminal, wherein the base station transmits using a downlink subframe on a first channel and the terminals transmit using an uplink subframe on a second channel, wherein the downlink subframe includes a broadcast preamble and a Time Division Multiple Access (TDMA) portion, and wherein the TDMA portion includes a first modulation/forward error correction (PHY) mode with an associated preamble which is only intended for the first terminal, and a second PHY mode with an associated preamble which is only intended for the second terminal, the method comprising:

transmitting a broadcast preamble from a base station to a first terminal and a second terminal during a downlink subframe on a first channel;

synchronizing the first and the second terminals to the base station based on the broadcast preamble;

transmitting a first preamble by the base station using a smart antenna on the first channel to only the first terminal after transmitting the broadcast preamble, wherein the first preamble is associated with a first PHY mode;

re-synchronizing the first terminal with the base station based on the first preamble transmitted by the base station;

transmitting modulated data from the base station using the smart antenna on the first channel to only the first terminal during the downlink subframe using the first PHY mode after the first terminal is synchronized with the base station;

transmitting a second preamble by the base station using the smart antenna on the first channel to only the second terminal after transmitting the modulated data to the first terminal, wherein the second preamble is associated with a second PHY mode; and

re-synchronizing the second terminal with the base station based on the second preamble transmitted by the base station.

45. The method of Claim 44, further comprising transmitting modulated data from the base station on the first channel to only the second terminal during the downlink subframe using the second PHY mode after the second terminal is synchronized with the base station.

46. The method of Claim 45, further comprising transmitting a broadcast downlink map by the base station and during the downlink subframe which indicates when the first preamble is to be transmitted by the base station.

47. The method of Claim 46, wherein the broadcast downlink map includes at least one time indicator and a downlink interval usage code (DIUC), wherein the DIUC is indicative of the first PHY mode.

48. The method of Claim 47, further comprising transmitting a broadcast uplink map by the base station and during the downlink subframe which indicates when the first terminal is to transmit modulated data on a second channel to the base station during an uplink subframe.

49. The method of Claim 48, wherein the downlink subframe and the uplink subframe have a combined duration of 0.5 milliseconds.

50. The method of Claim 49, wherein the downlink subframe and the uplink subframe have a combined duration of 1 milliseconds.

51. The method of Claim 49, wherein the downlink subframe and the uplink subframe have a combined duration of 2 milliseconds.

52. The method of Claim 49, wherein the duration of the downlink subframe and the duration of the uplink subframe vary over time.

53. The method of Claim 49, wherein transmitting to the first terminal and transmitting to the second terminal, both by the base station, is performed using different PHY modes.

54. The method of Claim of 53, wherein transmissions during the uplink subframe and the downlink subframe are modulated using Quadrature Amplitude Modulation (QAM) symbols of adaptable modulation density.

55. The method of Claim 53, wherein transmissions during the uplink subframe and the downlink subframe comprise Orthogonal Frequency Division Multiplexing (OFDM) symbols of adaptable modulation density.

56. The method of Claim 53, wherein the first terminal and the second terminal use the same modulation type with different forward error correction types.

57. A method for scheduling physical slots within a downlink subframe for a first receiver and a second receiver, each receiver assigned to a operate with a level of robustness, the receivers receiving data from a single transmitter in an adaptive modulation communication system, the method comprising:

providing data for a first receiver which have been assigned a level of robustness including a combination of modulation and forward error correction (FEC) types in a time division multiplex (TDM) section of the downlink subframe having a combination of modulation and FEC at least as robust as the level assigned to the particular recipient receiver; and

providing data for a second receiver in a Time Division Multiple Access (TDMA) section of the downlink subframe which provides a combination of modulation and FEC which is at least as robust as a level assigned to the receiver.

58. The method of Claim 57, wherein the TDM section is provided before providing the TDMA section.

59. The method of Claim 58, wherein the first receiver operates in a full-duplex fashion and the second receiver operates in a half-duplex fashion.

60. The method of Claim 58, wherein the first receiver and the second receiver operate in a full-duplex fashion.

61. The method of Claim 58, wherein the first receiver and the second receiver operate in a half-duplex fashion.

62. The method of Claim 57, further comprising providing data to a single transmitter from the first and second receivers during an uplink subframe.

63. The method of Claim 62, wherein the downlink subframe is transmitted on a first channel and the uplink subframe is transmitted on a second channel.

64. The method of Claim 62, wherein the downlink subframe and the uplink subframe are transmitted on the same channel.